SUPER LONG-SPAN BRIDGE R&D CENTER IN KOREA

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Abstract: *Launched in December 2008 through the two-year Preliminary Planning Research Project and the Detail Planning Research Project, the Super Long-Span Bridge Project has selected research institutes for the first and second core research projects and started research on May 29, 2009 and plans to conduct full-fledged R&D works by selecting the 3rd and 4th core project research institutes. Unlike existing research projects, this research will cover a core technology-type test bed that assesses the practicality of detailed technologies and an integrated technology-type test bed to verify and commercialize the developed technologies. It also aims to develop self-sufficient core technologies for a long-span bridge and expand the relevant industry to the global market using its technological advantage. The Super Long-Span Bridge R&D Center proposed a CONVERGENCE strategy that divides the entire research period into three different stages for implementation. The pursuit stage can be categorized as: CONcentration stage to develop various core technologies; VERification stage to assess the economical efficiency of the developed technologies; and lastly the GENeralization or realization stage to commercialization. The advanced countries have effectively utilized accumulated technologies for the existing long-span cable bridges through the local construction projects to lead key technologies and penetrate global markets. It is expected that the Super Long-Span Bridge R&D Center will serve as a medium for joint industry, university, research institute and government by taking advantage of Korea's activated long-span bridge market to pursue fully localized construction technologies and secure the world's best long-span bridge technologies and to contribute to the expansion of Korea's bridge construction companies into the global markets.*

Keywords: *Super Long-Span Bridge Project, Super Long-Span Bridge R&D Center, core research projects, CONVERGENCE, global markets*

1. INTRODUCTION

The Korean government carries out VC-10 (Value Creator-10) flagship projects as part of the Construction and Transportation R&D Program under the Ministry of Land, Transport and Maritime Affairs. In December 2008, the Korea Expressway Corporation was selected as the Super Long-Span Bridge R&D Center and maintenance to develop independent technologies for a long-span cable bridge and to cultivate a new engine for growth through core technology research and commercialization.

Figure 1: Super Long-Span Bridge R&D Project

*VC-10 (Value Creator-10) : Super Long Span Bridge Project, Urban Maglev Project, Aviation Safety Project, U-Eco City Project, SMART Highway Project, Super Tall Building Project, Next-Generation High-Speed Rail Project, Urban Regeneration Project, Land Spatialization Project, Seawater Desalination Plant Project

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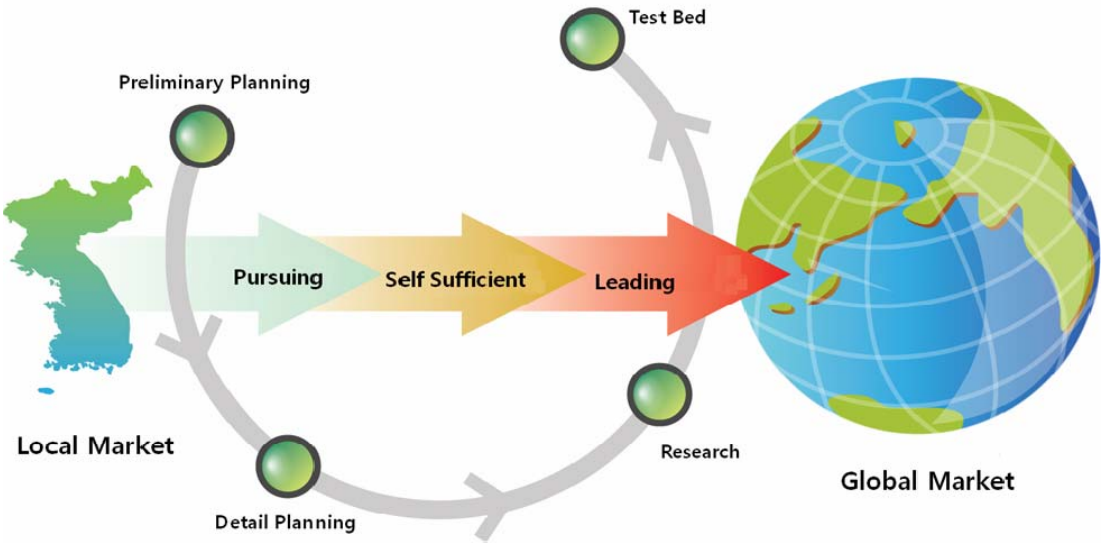

Figure 2: Conceptional promotion strategy of Super Long-Span Bridge R&D Center

The vision and goals of the Super Long-Span Bridge R&D Center, which have been carried out over about seven years from 2008 to 2015 costing a total of 87 million dollars including government budget support of 51 million dollars, were set for “the development of self-sufficient core technology for long-span cable bridge”, along with strategic objectives to realize the visions.

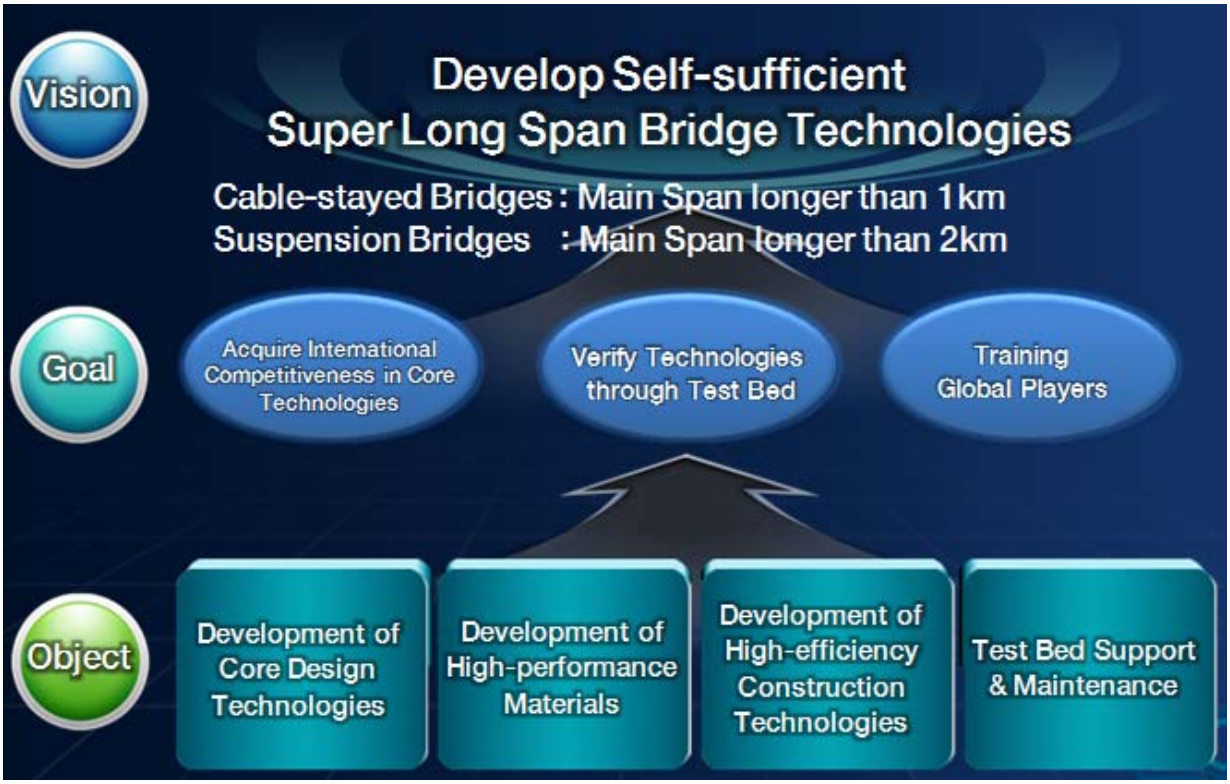

Figure 3: Visions and strategic goals

The Super Long-Span Bridge R&D Center is planning to conduct project verification with R&D and test beds based on the four core research projects such as “Development of core design technology”, “Development of high-performance material”, “Development of high-efficiency construction technology” and “Test bed support and maintenance technologies”. These projects were selected under the principles of choice and concentration, and it is planned that the technologies developed from each core research project will be assessed with pilot bridge and core-technology-type test beds during the core research project execution to assess their applicability and economic benefits.

2. CURRENT MARKET SITUATION

In general, a long-span bridge refers to a long-span cable bridge that is constructed to link the land with an island or one island with another, such as a cable-stayed bridge or a suspension bridge. In addition, as a landmark of the region, a long-span bridge plays the locomotive role for regional development. The best known suspension bridges include the Golden Gate Bridge (USA), the Akashi-Kaikyo Bridge (Japan), and the Great Belt Bridge (Denmark), and so on. As for a cable-stayed bridge, there are the Sutong Bridge (China), Stonecutters Bridge (Hong Kong) currently under construction and Tatara Bridge (Japan), etc.

Until 1990, the long-span cable bridge market had been developed in advanced countries such as Europe, the US and Japan and the technological leaders in the field in Europe and Japan have accumulated the necessary technologies found in the markets and actively exploited global markets throughout the world with strategic alliances and aggressive marketing. Recently, China has developed relevant technologies for long-span bridges based on her lively local market putting a lot of funds into social infrastructure and is expected to proactively expand the business to the global market as the technology reaches the mature stage.

The US financial crisis caused liquidity problems and weakened consumer consumption not only in the global financial market but also on the local and global economic horizon. The federal governments in

the US and Europe are seeking large-scale infrastructure investment projects to escape from credit crunches in market. It is expected that there will be a number of construction or renovation projects for long-span bridges to be included in large-scale national projects. Figure 4 shows the locations of the main long-span bridges planning in other countries. As the figure indicates, the demand for long-span bridges is extensively increasing throughout the world and is expected to expand further when the economy is recovered.

Figure 4: Construction plan of Long-Span Bridges in the global world

In Korea, there are 12 long-span cable bridges in operation including Seohae Grand Bridge, Yeongjong Bridge, Gwangan Bridge and 20 other cable bridges which can compete with world-famous bridges such as Incheon Bridge whose main span length is 800m, and Gwangyang Bridge whose main span length is 1545m, are either planned or already under construction. Moreover, it is expected that the construction of cable bridges under a mid/long-term plan such as Saecheonnyeon Bridge will be implemented early in accordance with the advanced project implementation plan announced by the Ministry of Land, Transport and Maritime Affairs this year.

The Korea cable bridge market has rapidly grown around the completion of Seohae Grand Bridge and Yeongjong Bridge construction works (2000), and is expected to grow into a 3.6 billion dollars market by 2010 and 5.4 billion dollars market by 2011. It signifies that Korea will create the second-largest cable bridge market following China. However, Korea technology of long-span cable bridges has been analyzed as 76% compared with that of advanced countries, and due to the lack of core technology of design, high-performance material and special equipment for construction, we have kept depending on the foreign advanced companies. According to a survey, it is expected that over 80 million dollars will be leaked to other countries in design expenditure and construction engineering costs for the planned long-span cable bridges. To avoid this, it is necessary to develop unique specialized technologies, to ensure price competitiveness and to verify technologies that are founded on the vibrant Korea cable bridge construction market and thus make it possible to form a strategic global consortium to penetrate the global market.

3. ORGANIZATION OF CORE RESEARCH PROJECT

The first core research project is to develop core design technology, covering technology development such as wind resistance design, ship collision analysis and other design necessities. Also, it deals with a

smart bridge that integrates cutting-edge IT technologies and bridge technologies to construct future-oriented bridges and an energy bridge that are focused on the application of new recycled energy to bridges. The core research institution is the Seoul National University Consortium (Chief Researcher: Prof. Go, Hyeon-Moo) and seeks to design a future-oriented long-span cable bridge that meets international standards with a goal to develop 100% independent core engineering technologies.

The second core research project, "high-performance strategic materials and utilization technology", mainly researches and develops the required high-performance materials and utilization technologies necessary to construct an economical and high-performance long-span bridge. The current world-class manufacturing technologies of high-performance steel and high-strength cables would enable the center to secure the technology leader's position when projects are completed. It is also planned to develop high-performance concrete and cables using cutting-edge complex materials that are appropriate to the construction of high-rise pylons or anchorages for a long-span cable bridge. Another core research institution, RIST consortium (Chief Researcher: Dr. Lee, Jong-gwan) pursues construction cost reduction and international competitiveness through high-performance materials with a view to develop and commercialize super long-span bridge structure materials.

As for the technology associated with the construction of a long-span cable bridge, high-efficiency construction technology will be developed in the third core research project. Key research items include cable erection and shape control technology for a suspension bridge, steel and concrete high-rise pylon construction technologies and economical composite foundation on soft ground or construction technologies in deep water depth and so on. The fourth core research project will mainly cover the realization of general test beds and the operational technology development of the maintenance and repair of the constructed bridges. The main institute for the 4th core research project will support the realization of the integrated test bed in cooperation with the center.

The main research institutes for the 3rd and 4th core research projects will be appointed in September 2009. The super long-span bridge R&D project will be implemented in three different stages: 1st stage to develop core technologies for 3 years; 2nd stage to verify individual technologies for 2 years; and the 3rd stage to realize a test bed for 2 years.

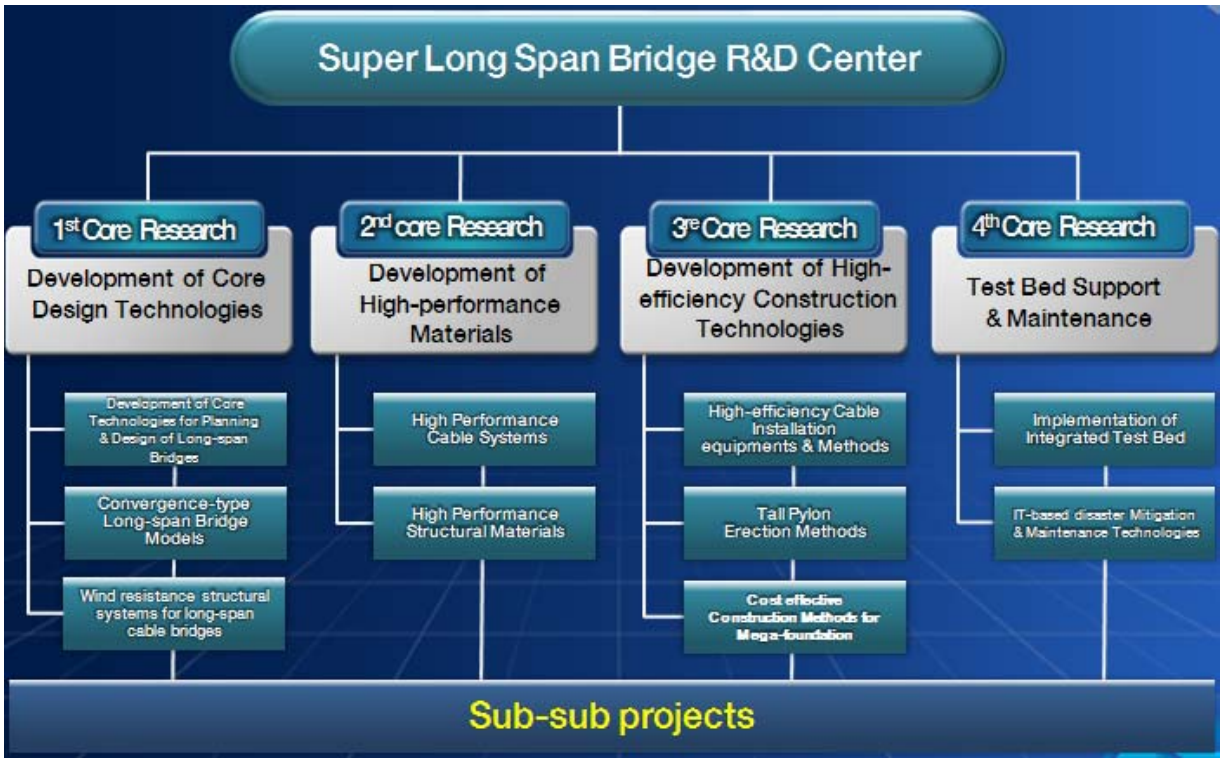

Figure 5: Organization of core research projects

4. CONCLUDING REMARKS

The advanced countries have effectively utilized accumulated technologies for the existing long-span cable bridges through the local construction projects to lead key technologies and penetrate global markets. It is expected that the Super Long-Span Bridge R&D Center will serve as a medium for joint industry, university, research institute and government by taking advantage of Korea's activated long-span bridge market to pursue fully localized construction technologies and secure the world's technologies and to contribute to the expansion of Korea's bridge construction companies to go into the global markets.

The super long-span bridge project is a large-scale research project that requires the systematic and organic participation of specialists from designing companies, construction companies, research institutes and academia in the fields of design, construction, maintenance and repair. The center will do its best to ensure the research results are practical and competitive internationally, and prepare an operational organization and research project management system to systematically support the projects through structured management.

ACKNOWLEDGEMENTS

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REFERENCES

[1] AAHTO. 2004. AASHTO LRFD Bridge Design Specifications.
[2] COWI. 2006. Yeosu-Sandan Lot3 Suspension Bridge : Ship Collision Risk Study. Report No. P-064361-TN-003, Yooshin Engineering Corporation.
[3] Eurocode. 2002. Eurocode 1. Actions on Structures, European Committee for Standardization.
[4] The Ministry of Land, Transport and Maritime Affairs (Korea). 2007. Preliminary planning research project on Super-long Span Cable Bidge.
[5] The Ministry of Land, Transport and Maritime Affairs (Korea). 2008. Detail planning research project on Super-long Span Cable Bidge.
[6] SAMSUNG Corporation JV. 2006. INCHEON Bridge Project : Design Package No. 11 Ship Impact Protection. DSN-11-SIP-NCR(EK), KODA Development Co., Ltd.